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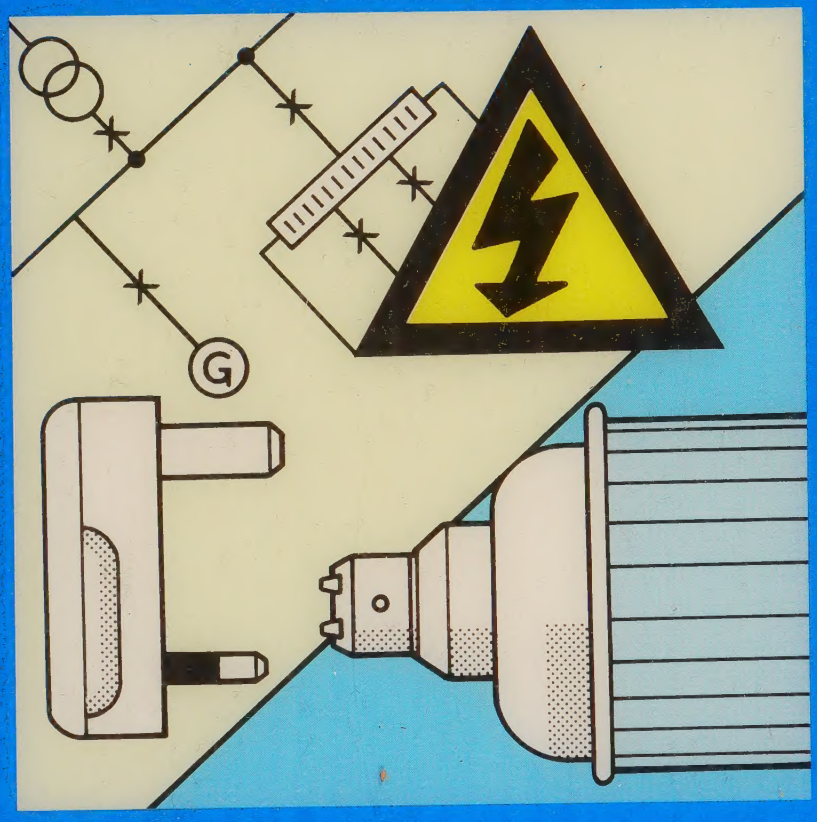
Health Technical Memorandum 2007

Health Technical Memorandum 2007

Management policy

Electrical services: supply and distribution



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Health Technical Memorandum 2007

Management policy

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About this publication

Health Technical Memoranda (HTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

They are applicable to new and existing sites, and are of use at various stages during the inception, design, construction, refurbishment and maintenance of a building.

Health Technical Memorandum 2007

HTM 2007 focuses on the

a. legal and mandatory requirements;

b. design applications;

c. maintenance;

d. operation

of electrical services supply and distribution in all types of healthcare and personal social services premises.

It is published as four separate volumes, each addressing a specialist discipline:

- this volume – **Management policy** – outlines the overall responsibility of managers of healthcare and personal social services premises, and details their legal and mandatory obligations in setting up and operating reliable, efficient and economic electrical services. It summarises the technical aspects involved and concludes with a list of definitions;

- **Design considerations** – details the requirements and considerations that should be applied to the design of electrical services up to the contract document. Guidance is given on the choice of supply, distribution voltages, equipment, cabling and utilisation circuits. Typical system layout and sub-station/ switchroom configurations are also shown;

- **Validation and verification** – details the requirements for ensuring that manufactured equipment is formally tested and certified as to contract, and manufactured to the highest

level of quality assurance. The importance of commissioning is emphasised and the order of tests on site is listed. Routine testing, which is a subset of these commissioning tests, is also reviewed;

- **Operational management** – provides information for those responsible for overseeing and operating day-to-day running and maintenance. Coverage includes routine tests, planned preventive maintenance and troubleshooting.

Guidance in this Health Technical Memorandum is complemented by the library of National Health Services Model Engineering Specifications. Users of the guidance are advised to refer to the relevant specifications for "Electrical services".

The contents of this Health Technical Memorandum in terms of management policy, operational policy and technical guidance are endorsed by:

a. the Welsh Office for the NHS in Wales;

b. the Health and Personal Social Services Management Executive in Northern Ireland;

c. the National Health Service in Scotland Management Executive,

and they set standards consistent with Departmental Cost Allowances.

Statutory guidance on electrical safety to meet the Electricity at Work Regulations 1989 is published in HTM 2020 – 'Electrical safety code for low voltage systems' and HTM 2021 – 'Electrical safety code for high voltage systems'.

Guidance on emergency electrical requirements is published in HTM 2011 – 'Emergency electrical services'. Guidance on reduction of electrical interference is given in HTM 2014 – 'Abatement of electrical interference'.

References to legislation appearing in the main text of this guidance apply in England and Wales. Where references differ for Scotland and/or Northern Ireland, these are given as marginal notes.

Where appropriate, marginal notes are also used to amplify the text.

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Contents

About this publication

1 Scope *page 3*

2 Management responsibilities *page 4*
2.1 Statutory requirements
2.4 Other obligations
2.6 Functional guidance
2.12 Installation and commissioning of electrical services
2.14 Quality assurance
2.15 Operation and maintenance of electrical equipment
2.17 Additional electrical load
2.19 Safety at work
2.21 Monitoring and recording procedures

3 Design of installation for growth *page 8*

4 Electrical supplies, tariffs and maximum demand *page 9*

5 Supply voltage *page 10*

6 Distribution systems *page 11*
6.1 General
6.3 Essential services supply
6.6 Voltage fluctuations

7 Designated staff functions *page 12*

8 Definitions *page 13*

Other publications in this series *page 14*

About NHS Estates *page 15*

1.0 Scope

General

1.1 Electrical services form an integral part of the healthcare and personal social services premises (HCP) supply and distribution network in meeting both safety and functional requirements.

1.2 The provision of electrical services in HCPs is a management responsibility at both new and existing sites. This guidance is equally applicable to premises which offer acute healthcare services under the Registered Homes Act 1984.

Nursing Homes & Agencies Act (Northern Ireland) 1971
Nursing Homes Regulations (Northern Ireland) 1974
Registered Establishments (Scotland) Act 1987
Electricity at Work Regulations (Northern Ireland), SI 191/13

1.3 This guidance also provides an insight into the requirements of the Electricity at Work Regulations 1989.

1.4 Healthcare and personal social services premises are totally dependent upon electrical power supplies, not only to maintain a safer and more comfortable environment for patients and staff, but also to give greater scope for treatment using sophisticated medical equipment at all levels of clinical and surgical care. Changes in application, design and statutory requirements have led to the introduction of a new generation of equipment and new standards of reliability; hence, a large expansion of material is included in this HTM.

1.5 Interruptions in electrical power supplies to equipment can seriously disrupt the delivery of healthcare, with serious consequences for patient well-being. Healthcare and personal social services premises must therefore ensure that their electrical installation provides maximum reliability and integrity of supplies. Every effort must be made to reduce the probability of equipment failure due to loss of power from the regional electricity company and from internal emergency power sources.

2.0 Management responsibilities

Statutory requirements

2.1 It is the responsibility of the general managers/chief executives to ensure that their premises comply with all statutes.

2.2 Managers (owners or occupiers) of healthcare and personal social services premises (the latter are premises registered on behalf of the Secretary of State under the Registered Homes Act 1984) have an overriding general duty of care under the Health and Safety at Work etc Act 1974 (the HSW Act 1974).

Health and Safety at Work (Northern Ireland) Order 1978 SI 1979/1039 NI 9

2.3 Electrical supply and distribution services, including all manufactured equipment, must comply with the following legislation in all or in part as applicable:

a. the Electricity Act 1989;

b. the Electricity Supply Regulations 1988 (as amended 1990). This imposes requirements regarding the installation and use of electric lines and apparatus of suppliers of electricity, including provisions for connections with earth. These Regulations are administered by the Engineering Inspectorate of the Electricity Division of the Department of Energy and may impose requirements which are in addition to those of the Electricity at Work Regulations;

Electricity (Northern Ireland) Requirements Order 1991
Electricity Supply Regulations (Northern Ireland), SI 1991/536 NI

c. the Electricity at Work Regulations 1989. The principal statutory requirement for electrical safety in the workplace is the Electricity at Work Regulations 1989 (SI No 1989/635). The Regulations came into force on 1 April 1990. The purpose of the Regulations is to require precautions to be taken against the risk of death or personal injury from electricity in work activities;

d. the Health and Safety at Work etc Act 1974;

e. the Clean Air Act 1956;

Clean Air (Northern Ireland) Order 1981, SI 1981/158 NI4

f. the Health and Safety Executive document 'Occupational Exposure Limits' (OEL), 'Annual Guidance Note EH/40/1992' (this document is updated annually);

g. the Control of Substances Hazardous to Health Regulations (COSHH) 1988;

Control of Substances Hazardous to Health Regulations (Northern Ireland) 1990 SR 1990/374

h. the Energy Act 1983;

Electricity (Northern Ireland) Order 1991

j. the Safety Signs Regulations 1980;

Safety Signs Regulations (Northern Ireland) SR 1981 No 352

k. G59/1: Recommendations for Embedded Generator Plant connected to Regional Electricity Company Supplies (Electricity Association);

m. report ET113 Protection of Generating sets up to 5 MW for parallel operations with Regional Electricity Company supplies (Electricity Association).

Other obligations

2.4 Management has a responsibility for ensuring that all electrical systems and equipment are specified, designed, installed, operated and maintained correctly.

2.5 In order to satisfy these requirements, management has to:

a. formulate an electrical services policy indicating their commitment to the safe operation and maintenance of the electrical system;

b. monitor this policy to ensure its effectiveness;

c. keep abreast of the appropriate training for relevant professional and technical staff.

Functional guidance

2.6 Management should ensure that all electrical services meet their functional requirements to a high degree of reliability. Guidance and advice is given in HTM 2007 on the various aspects of electrical design, installation, commissioning, operation and economies. The following topics are included:

a. scheme planning;

b. liaison with other disciplines;

c. electricity supply tariff and voltage;

d. electricity distribution philosophy;

e. detailed project specification;

f. load growth and change;

g. maximum demand and power factor;

h. diversity;

j. emergency supply arrangements;

k. patient safety in clinical locations.

2.7 Guidance notes and other publications issued from time to time by the Department, the Health and Safety Executive (HSE) and by the Institution of Electrical Engineers, give detailed advice or legal requirements on such matters as design of certain equipment, safe working practices, maintenance and repair of equipment, and installation methods for particular environments.

2.8 There exist many national and international organisations, for example BSI (British Standards Institution), IEC (International Electrotechnical Commission), ISO (International Organisation for Standardisation) and CENELEC (the European Committee for Electrotechnical Standardisation). These bodies produce written standards, codes of practices and procedures applicable to particular industries, processes or hazards. Such codes may provide useful detailed expansion of the guidance given in this HTM.

2.9 The IEE Wiring Regulations (BS7671:1992) are published by the IEE. They relate principally to the design, selection, erection, inspection and testing of electrical installations. These regulations are framed to guide and protect against hazards arising in any installation that may cause electrical shock, burns, injury, or induced fire. They are intended to be cited as a guidance document, if referred to in any contract. They are not intended to take the place of a detailed specification or to provide for every circumstance.

2.10 Compliance with British Standards or IEC, ISO and harmonised European Standards (EN) should be specified insofar as they are applicable. Where no accepted standard or independent EC type-examination certification or "CE" mark is available, special care should be taken with the manufacturer's specification.

2.11 IEC or ISO standards, by agreement, are harmonised and adopted by those EC and EFTA countries represented on CENELEC. These standards are recognised as the minimum standard of manufacture by the European Court of the EC.

Installation and commissioning of electrical services

2.12 Before being put into service, every electrical installation should be inspected and tested to verify that the requirements of the contract document and appropriate regulations are met.

2.13 At the appropriate stages of installation/commissioning and following periodic testing, formal completion and inspection certificates should be provided to form part of the record documentation.

Quality assurance

2.14 Reliability is of prime importance with equipment used in electrical installations. Equipment manufacturers and suppliers subject to the internal assessment and inspectorate services based upon BS5750 (ISO 9000) – 'Quality systems' and BS9000 – 'Electronic components of assessed quality' should be encouraged and supported. Independent inspection should be used wherever practical or possible.

Operation and maintenance of electrical equipment

2.15 Regular maintenance enhances the safety standards associated with an electrical system. A policy to carry out planned preventive maintenance should be introduced.

2.16 Irrespective of the scale of operation, maintenance programmes are essential to ensure that electrical equipment is checked, inspected, tested, repaired or replaced at times when operating demand is at a minimum. The frequency of maintenance will be influenced by several operating factors:

a. quality of manufacture;

b. frequency of use;

c. environmental conditions;

d. skill of the operator;

e. importance of the service.

Additional electrical load

2.17 The connection of small or large electrical equipment to an electrical supply system should be regulated. All fixed or portable items of electrical equipment which are connected to the electrical supply should be subject to registration for approved use by the authorised person responsible for the electrical supply and distribution systems.

2.18 The on-cost of any new equipment or service, which increases the electrical load, should include any additional retro-fit costs where necessary to continue the safe operation of the electrical system.

Safety at work

2.19 Management is responsible for the provision of clear guidance on safe electrical working practices and emergency procedures. This is indicated in HTM 2020 – 'Electrical safety code for low voltage systems' and HTM 2021 – 'Electrical safety code for high voltage systems'.

2.20 It is a requirement of the Electricity at Work Regulations 1989 (the Regulations) that the management, design, installation, testing, commissioning and operation of an electrical system and connected equipment is performed in a manner so as to prevent danger.

Monitoring and recording procedures

2.21 Full records of original and amended drawings, planned preventive maintenance, routine maintenance, breakdown maintenance and incidents, etc should be formally kept. Effective monitoring and record-keeping will assist duty holders to demonstrate their compliance with the requirements of the Health and Safety at Work etc Act 1974 and supporting Electricity at Work Regulations 1989.

2.22 Enquiries or proceedings may arise related to an offence contravening the Regulations. Management's strategy and effectiveness of monitoring procedures may be the duty holder's main or only defence in proving that all reasonable steps had been taken in the exercise of due diligence to avoid such an offence.

2.23 At appropriate stages in the installation/commissioning of a new project, a formal "construction certificate" should be completed by the design engineer. This certificate will confirm that the contractor has completed the installation in accordance with the design, calculations and drawings issued by the designer. Test certificates, "as-fitted" drawings, operation and maintenance manuals should be provided by the installation contractor where applicable.

2.24 A statement of "design intent" should be provided by the design engineer. This is to be included within the operations manual and give full details of the operation, interlocking and control of the electrical system.

2.25 Any alterations carried out since commissioning should be recorded on the original "as-fitted" drawings, documents and schedules.

3.0 Design of installation for growth

3.1 The design of electrical services in HCPs should be flexible within cost limits to allow for future additions/alterations.

3.2 Subsequent additions to an installation, unless planned or allowed for during the original construction, can prove costly. The aim should be to make adequate provision for known requirements. This includes spare capacity in transformers, cables and bus-bars and, where practicable, suitable provision should be made to extend the installation. It is important to note that an increase in cable size initially is relatively inexpensive compared to the cost of installing an additional cable later.

4.0 Electrical supplies, tariffs and maximum demand

4.1 The type and choice of tariff available to HCPs can vary considerably. Tariffs should be discussed at an early stage with the commercial engineer of a regional electricity company (REC) or any other supplier. The discussions should focus on preferential tariffs. Guarantees for the reliability and integrity of electrical supplies should be emphasised.

4.2 Normally, two basic types of tariff are available. These are "block" or "maximum demand". There is a maximum limit for block tariffs and a minimum limit for maximum demand tariffs. These values vary with different electricity suppliers. Possible variations in both the basic types of tariff include reduced rates for off-peak (night and/or weekend) consumption.

4.3 The estimated maximum power demand will partly determine the capacity of the supply load rating and location of main distribution equipment.

4.4 The maximum power demand in kW and maximum load in kVA, together with the method of distribution, will influence negotiations on the final tariff agreed.

4.5 Among the factors which will increase maximum demands are deep plan designed buildings which require higher standards of illumination and mechanical ventilation.

4.6 The power factor (pf) of an electrical system is a simple arithmetical ratio of the electrical supply input in kilowatts (kW) divided by the product of the input kilovoltage x amperes. This is represented arithmetically as:

$$pf = \frac{kW}{kVA}$$

4.7 The power factor of an HCP is always inductive. This is indicated by a lagging pf of less than unity. Low values of lagging pf can invoke a penalty charge by the REC because of the introduction into its system of unforeseen current overloading and loss of potential earnings.

4.8 The penalty charge can be reduced by the use of equipment known as power factor correction (or compensation) (PFC) equipment.

5.0 Supply voltage

5.1 The voltage at which the REC will supply electrical power is determined by the facilities available, the prospective load and the extent of the distribution system. There are three options:

a. a low voltage supply (normally 240 V/415 V, 50 Hz, single phase or three phase – four wire) direct from the REC's low voltage network;

b. a low voltage supply provided from a high voltage transformer belonging to the REC, housed in a sub-station compound located on the HCP. This transformer could either be for the sole use of that premises or could jointly supply other consumers. This type of supply is suitable for medium-sized operations (less than 300 kVA);

c. a dedicated high voltage supply (normally 11 kV, three-phase) from the REC high voltage network. At the consumer side of the supply terminals, that is, after the metering equipment, the HCP will be responsible for providing, operating and maintaining the high voltage transformers, associated switchgear and cabling.

5.2 Consultation with the REC is necessary at an early stage. This will ensure a secure facility is available to meet load demands, based on best technical and economical terms.

5.3 In urban areas and where the maximum demand of the HCP is high, the REC could provide a second high voltage feeder. In rural areas, the additional cost of a second feeder will only be economically advantageous where suitable overhead lines and/or buried cable routes are available.

6.0 Distribution systems

General

6.1 The distribution system should be designed to provide:

a. security of supply;

b. flexibility in adaptation;

c. safety in operation and maintenance.

All these factors should be considered within the cost constraints.

6.2 Provision in the design should allow space for future expansion. At an early stage in the design, the distribution system should be assessed for safe and flexible operational requirements and the provision of an emergency supply (see HTM 2011 – 'Emergency electrical services').

Essential services supply

6.3 The increasing dependence of medical and nursing procedures on electrical equipment calls for special attention to the HCP electrical distribution system. Emergency generating plant should be available to provide electrical power to those areas which will enable the HCP to carry out its essential functions. Within this general objective, the aim should be to simplify the electrical installations as far as is practicable, and avoid unnecessary segregation and repetition in essential and non-essential circuits, particularly for lighting circuits where comparatively small loads are involved.

6.4 Where new HCPs are built in separate construction phases, the essential power supply for the whole should as far as possible be planned and evaluated at the design stage. This will enable the total emergency power supply to be assessed in the early planning stages and appropriate areas of accommodation allocated. A.c. generator sets, as required, should be installed early in each of the phases of development to ensure that the maximum security of emergency power is available from the outset, and suitable staff training obtained.

6.5 Essential power supply facilities for an existing HCP should be periodically re-assessed. Upgrading of emergency power should be considered to maintain essential clinical and surgical life-support facilities.

Voltage fluctuations

6.6 To comply with the IEE Wiring Regulations, the low voltage installation conductors should be selected to ensure that the fall in voltage, at full load currents, does not exceed 4% measured from the supply terminals to the fixed equipment.

7.0 Designated staff functions

7.1 Only trained authorised and competent persons should be appointed by management to control the operation of electrical services.

7.2 Management: the owner, occupier, employer, general manager, chief executive or other person who is accountable for the premises and is responsible for issuing or implementing a general policy statement under the HSW Act 1974.

7.3 Designated person: an individual who has overall authority and responsibility for the premises containing the electrical supply and distribution system, and has a duty under the HSW Act 1974 to prepare and issue a general policy statement on health and safety at work, including the organisation and arrangements for carrying out that policy. This person should not be the authorising engineer.

7.4 Duty holder: a person on whom the Electricity at Work Regulations 1989 impose a duty in connection with safety.

7.5 Employer: any person or body who:

a. employs one or more individuals under a contract of employment or apprenticeship;

b. provides training under the schemes to which the Health and Safety (Training for Employment) Regulations 1988 (SI No 1988/1222) apply.

Northern Ireland: Health and Safety (Training for Employment) Regulations 1990, SI 1990/1380

7.6 Authorising engineer (high voltage): a Chartered Electrical Engineer with appropriate experience and possessing the necessary degree of independence from local management, who is appointed in writing by management to implement, administer and monitor the safety arrangements for the high voltage electrical supply and distribution systems of that organisation to ensure compliance with the Electricity at Work Regulations 1989, and to assess the suitability and appointment of candidates in writing to be authorised persons (see HTM 2021 – 'Electrical safety code for high voltage systems').

7.7 Authorising engineer (low voltage): a Chartered Engineer or Incorporated Electrical Engineer with appropriate experience and possessing the necessary degree of independence from local management, who is appointed in writing by management to implement, administer and monitor the safety arrangements for the low voltage electrical supply and distribution systems of that organisation to ensure compliance with the Electricity at Work Regulations 1989, and to assess the suitability and appointment of candidates in writing to be authorised persons (see HTM 2020 – 'Electrical safety code for low voltage systems').

7.8 Authorised person: an individual possessing adequate technical knowledge and having received appropriate training, appointed in writing by the authorising engineer to be responsible for the practical implementation and operation of management's safety policy and procedures on defined electrical systems (see HTMs 2021 and 2020).

7.9 Competent person: an individual who in the opinion of an authorised person has sufficient technical knowledge and experience to prevent danger while carrying out work on defined electrical systems (see HTMs 2021 and 2020).

8.0 Definitions

8.1 Department: an abbreviation of the generic term "UK Health Departments" (the Department of Health, the Scottish Office, the Welsh Office, and the Department of Health and Social Services Northern Ireland).

8.2 Injury: death or personal injury from electrical shock, electrical burn, electrical explosion or arcing, or from fire or explosion initiated by electrical energy.

8.3 Danger: a risk of injury.

8.4 System: a system in which all the electrical equipment is, or may be, electrically connected to a common source of electrical energy, including such source and such equipment.

8.5 Essential circuits: circuits forming part of the essential services electrical supply, so arranged that they can be supplied separately from the remainder of the electrical installation.

8.6 Generator set: an engine-driven synchronous a.c. generator with exciter and other essential components to generate electrical power, that is, it can be started and run independently of any external electrical supply.

8.7 Emergency supply: any form of electrical supply which is intended to be available in the event of a failure in the normal supply.

8.8 Essential service electrical supply: the supply from an engine-driven a.c. emergency generator which is arranged to come into operation in the event of a failure of the normal supply and provide sufficient electrical energy to ensure that all basic functions of the HCP are maintained in service.

8.9 No-break supply: a circuit continuously energised whether or not the normal supply is available.

8.10 Electrical equipment: includes anything used, intended to be used or installed for use to generate, provide, transmit, transform, conduct, distribute, control, measure or use electrical energy.

8.11 Equipment: abbreviation of electrical equipment.

8.12 High voltage (HV): the existence of a potential difference (rms value for a.c.) normally exceeding 1000 volts a.c. between circuit conductors or 600 volts between circuit conductors and earth.

8.13 Low voltage (LV): the existence of a potential difference (rms value for a.c.) not exceeding 1000 volts a.c. or 1500 volts d.c. between circuit conductors or 600 volts a.c. or 900 volts d.c. between circuit conductors and earth.

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1 Anti-static precautions: rubber, plastics and fabrics*†
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9 –
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12 –
13 –
2014 Abatement of electrical interference, 1993.
15 Patient/nurse call systems†
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17 Health building engineering installations: commissioning and associated activities, 1978.
18 Facsimile telegraphy: possible applications in DGHs†
19 Facsimile telegraphy: the transmission of pathology reports within a hospital – a case study†
2020 Electrical safety code for low voltage systems, 1993.
2021 Electrical safety code for high voltage systems, 1993.
22 Piped medical gases, medical compressed air and medical vacuum installations*†
22 Supp. Permit to work system: for piped medical gases etc†
23 Access and accommodation for engineering services†
24 –
25 –
26 Commissioning of oil, gas and dual fired boilers: with notes on design, operation and maintenance†
27 Cold water supply storage and mains distribution* [Revised version will deal with water storage and distribution], 1978.
28 to 39 –
2040 The control of legionellae in healthcare premises – a code of practice, 1993.
41 to 53 –

Component DataBase (HTMs 54 to 70)

54.1 User manual, 1993.
55 Windows, 1989.
56 Partitions, 1989.
57 Internal glazing, 1989.
58 Internal doorsets, 1989.
59 Ironmongery, 1989.
60 Ceilings, 1989.
61 Flooring, 1989.
62 Demountable storage systems, 1989.
63 Fitted storage systems, 1989.
64 Sanitary assemblies, 1989.
65 Signs†
66 Cubicle curtain track, 1989.
67 Laboratory fitting-out system, 1993.
68 Ducts and panel assemblies, 1993.
69 Protection, 1993.
70 Fixings, 1993.
71 to 80 –

Firecode

81 Firecode: fire precautions in new hospitals, 1987.
81 Supp 1, 1993.
82 Firecode: alarm and detection systems, 1989.
83 Fire safety in healthcare premises: general fire precautions*†
85 [Revision to Home Office draft guidance in preparation]
86 Firecode: assessing fire risks in existing hospital wards, 1987.
87 Firecode: textiles and furniture, 1993.
88 Fire safety in healthcare premises: guide to fire precautions in NHS housing in the community for mentally handicapped/ill people, 1986.

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Health Building Notes – advice for project teams procuring new buildings and adapting or extending existing buildings. *HMSO*

Health Facilities Notes – debate current and topical issues of concern across all areas of healthcare provision. *HMSO*

Health Guidance Notes – an occasional series of publications which respond to changes in Department of Health policy or reflect changing NHS operational management. Each deals with a specific topic and is complementary to a related Health Technical Memorandum. *HMSO*

Encode – shows how to plan and implement a policy of energy efficiency in a building. *HMSO*

Firecode – for policy, technical guidance and specialist aspects of fire precautions. *HMSO*

Nucleus – standardised briefing and planning system combining appropriate standards of clinical care and service with maximum economy in capital and running costs. *NHS Estates*

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